implemented the readout in detector-specific firmware, running at a sampling rate of 100 kHz. This allows us to initiate interlocks in a few ms whenever limits are exceeded. Figure 1 shows the Hall probe signal during the application of a corrupt line. We simulated two position errors of ± 1 mm at iso-center during its application; both clearly visible (peak downwards, peak upwards). In the redundant verification step, we compared the dose profile of each line, measured with a strip chamber in the nozzle, to a forward-calculated expectation.

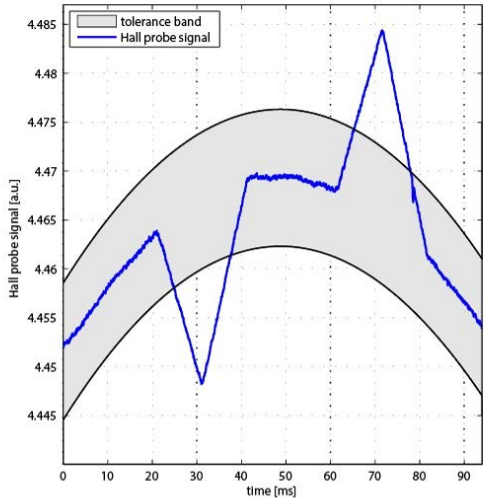

Figure 1: Measured Hall probe signal during the application of a corrupt line. Both delivery errors in position (± 1 mm at iso-center) push the signal outside of the pre-defined tolerance band (here at t_1 = 25 ms and t_2 = 65 ms). Short reaction times in initiating interlocks prevent clinically unacceptable distortions of the delivered dose distribution. The curved signal shape originates from a non-linear correlation between the magnetic field of the sweeper and the actual beam position.

Conclusion: Line scanning is a fast scanning technique; well-suited to rescanning, because it can deliver entire low-dose fields within a few seconds. The combination of real-time verification and dose profile validation ensures safe beam delivery. Interlocks can be initiated quickly during the application of a line if continuously monitored signals exceed pre-defined tolerance limits.

PO-0796

Dose rate dependence of the PTW 60019 microDiamond detector in high dose-per-pulse pulsed beams

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Purpose or Objective: Recombination can affect detectors used for the dosimetry of radiotherapy fields, and should be corrected for. The introduction of FFF accelerators increases the typical dose-per-pulse (DPP) used in radiotherapy, which leads to more important recombination effects.
Diamond detectors provide a good solution for the dosimetry of small fields, due to their low energy dependence and small volume. The group of Università di Roma Tor Vergata has developed a synthetic diamond detector, commercialized by PTW as microDiamond. In this work we present an experimental characterization of the collection efficiency of the this detector, focusing on high-DPP, FFF beams.

Material and Methods: Measurements were performed in a Truebeam linac (Varian) with FF and FFF modalities. The microDiamond chamber was placed in a cubic PMMA phantom at 10 cm depth, the detector axis perpendicular to the beam axis. The source-to-detector distance was varied between 70 cm and 150 cm to change the DPP. The detector was irradiated with different modalities (6MV-FFF, 10MV-FFF, and 10 MV for reference) and monitor unit rates. The detector was pre-irradiated with ~15 Gy, enough to achieve signal stability. Leakage current was measured before and after each irradiation, and was always found to be <0.1 pA. We also performed measurements with a CC13 air ionization chamber (IBA, Belgium) for reference. Collection efficiencies for the microDiamond detector can qualitatively be obtained from ratios of detector readings.

Results: The collection efficiency decreases with DPP, down to 0.978 at 2.2 mGy/pulse. The effect is within 1.1% in the range 0.1-2.2 mGy/pulse, referred to 0.5 mGy/pulse. This dependence is similar to the value reported in the user manual in a narrower dose-per-pulse range (0.05-0.8 mGy).
The collection efficiency versus DPP curve does not show the typical linear dependence observed in the near saturation region for ionization chambers, but an equation based on the Fowler-Attix model provides a good fit. Such different behaviour is not surprising: recombination in diamond detectors is a more complex physical process than it is in ionization chambers, with impurities playing a significant role.
On the other hand, we have found no significant dependence of the collection efficiency on pulse repetition frequency.

Conclusion: The dose rate dependence of the microDiamond is within 1.1% in the range 0.1-2.2 mGy/pulse referred to 0.5 mGy/pulse The dependence, though moderate, can cause some systematic discrepancies when measuring FFF beams with different DPP values and should probably be considered.

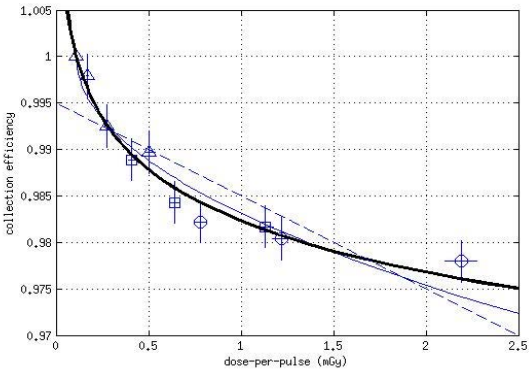

Figure. MicroDiamond collection efficiencies versus DPP: 10 MV (triangles), 6MV-FFF (boxes) and 10MV-FFF beams (circles). Best fits to a linear dependence on the dose-per-pulse (dashed line), an equation with a square root dependence (thin solid line), and the Fowler-Attix expression (thick solid line), are showed.

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Advanced Radiation Dosimetry System (ARDOS) - A novel breathing phantom for radiation therapy

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Purpose or Objective: Nowadays an increasing number of techniques that account and compensate for 4D tumor motion are proposed, investigated and implemented into